20. Workers come to a tool store room to enquire about the special tools (require by them) for a particular. The average time between the arrivals is 60 seconds and the arrivals are assumed to be in Poisson distribution. The average service time is 40 seconds. Determine

(a) Average queue length

(b) Average length of non-empty queues

(c) Average number of workers in the system including the workers being attended

(d) Mean waiting time of an arrival

(e) Average waiting time of an arrival (workers) who waits.

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NOVEMBER/DECEMBER 2025

23PECM14B — OPERATIONS RESEARCH

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define feasible solution.

2. What are the two forms of LPP?

3. State the merits of using North-west corner rule.

4. Give two applications of Assignment problem.

5. Define the value of game.

6. State the rule for determining saddle point.

7. What is replacement?

8. What are the two basic planning and control techniques in a network analysis?

9. Mention the basic characteristics of a queuing system.

10. State the classifications of decision.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL questions.

11. (a) Use graphical methods to solve the following LPP.

Maximize : $Z = 2x_2 + 3x_2$

Subject to the constrains:

$x_1 + x_2 \leq 30$

$X_1 - x_2 \geq 0$

$X_2 \geq 3$

$0 \leq x_1 \leq 20$ *and* $0 \leq x_2 \leq 12$

Or

(b) What is linear programming problem? Summarize the procedure for the graphical solution to a linear programming problem.

19. A fleet owner has three trucks, two of which are two years old and third one s one year old. The annual cost for a smaller truck is Rs 68,000; Rs. 64,500; Rs. 64,000; 64,500 and Rs. 66,400 during first, second, third, fourth and fifth year respectively. He is considering a new type of large truck with 50% more capacity than one of the old ones at a purchase price of Rs. 4,00,000. The estimation of running cost and resale price for the new truck is as given below:

Year of service	Running Cost	Resale Price
1	24,000	3,00,000
2	28,000	2,76,000
3	32,000	2,52,000
4	40,000	2,28,000
5	48,000	2,04,000
6	56,000	1,80,000
7	68,000	1,50,000
8	84,000	1,00,000

Assuming that the loss of flexibility due to fewer trucks is of no importance and he continues to have sufficient work for these three trucks, what should be his replacement policy?

17. Solve the following Transportation problem using Vogel's Approximation Method

Factory	Warehouse						
	A	B	C	D	E	F	Availability
1	9	12	9	6	9	10	5
2	7	3	7	7	5	5	6
3	6	5	9	11	3	11	2
4	6	8	11	2	2	10	9
Requirement	4	4	6	2	4	2	

18. Obtain the optimal strategies for both persons and the value of the game for Zero – sum, two person game whose payoff matrix is as follows:

$$\begin{matrix} 1 & -3 \\ 3 & 5 \\ -1 & 6 \end{matrix}$$

$$\begin{matrix} 4 & 1 \\ 2 & 2 \\ -5 & 0 \end{matrix}$$

12. (a) Use Vogel's Approximation method to obtain an initial basic feasible solution of the transportation problem:

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

Or

(b) Explain the Hungarian Algorithm.

13. (a) Describe the method of processing in job through two machine.

Or

(b) Followings the pay-off matrix for player A

Player A	Player B				
	B_1	B_2	B_3	B_4	B_5
A_1	2	4	3	8	4
A_2	5	6	3	7	8
A_3	6	7	9	8	7
A_4	4	2	8	4	2

Using dominance property, obtain the optimum strategies for both the players and determine the value of the game.

14. (a) A truck owner finds from his past records that the maintenance costs per year of a truck, whose purchase price is Rs 8,000 are as given in the table that follows :

Year	1	2	3	4
Maintenance cost	1,000	1,300	1,700	2,200
Resale price	4,000	2,000	1,200	600
Year	5	6	7	8
Maintenance cost	2,900	3,000	4,800	6,000
Resale price	500	400	400	400

Determine the time at which it is profitable to replace the truck.

Or

(b) Draw the network and determine the Critical Path for the given data. Also calculate all the flats involved in CPM.

Jobs	1-2	1-3	2-4	3-4	3-5	4-5	4-6	5-6
Duration	6	5	10	3	4	6	2	9

15. (a) In a super market, the average arrivals rate of customers is 10 every 30 minutes, following Poisson process. The average time taken by a cashier to list and calculate the customer's purchase is two and a half minutes following exponential distribution. What is the probability that the queue length exceeds six? What s the expected time spent by a customer in the system?

Or

(b) What are the limitations of decision Tree approach?

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. A firm has availably of 240,370 and 180 Kg of wood, plastic and steel respectively. The firm produces two products A and. Each unit of A requires 1, 3 an 2 Kg of wood, plastic and steel respectively. The corresponding requirement for each unit of B is 3, 4 and 1 respectively. If A is sold for Rs. 4 and for Rs. 6 determine how many units of A and B should be produce in order to obtain the maximum gross income. Use the simplex method.